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and spore characters. It differs in being a *colored plant* and having a large head and slender stem. A splendid illustration of the plant was given by Petri (Ann. Mycologici, 1904, plate 6) under the name of *Tylostoma fimbriatum*, and drawn we think from American specimens.



NOTES FROM MUSHROOM LITERATURE IV.

W. A. Kellerman.

Mr. C. H. Kauffman, of the University of Michigan, has published in the Botanical Gazette some observations on *Cortinarius* as a Mycorrhiza-producing fungus. The fungi are very few which have been definitely reported as belonging to this class—in which the hyphae (mycelium) are intimately associated with roots of higher plants, and purveyors of nitrogen. We shall quote liberally from this interesting and important paper. “When we come to a consideration of the agarics our knowledge is meager indeed. Only one investigator, Noack, in 1899, has concerned himself with them. He found that five species of this group were apparently mycorrhiza-producers on the forest trees of the locality where he made his observations. Two were *Tricholomas*; one a *Lactarius*, and three were *Cortinarii*. He merely makes the bare statement that they are connected with the rootlets by mycelial strands, which he could easily make out. It is very probable that his observations are correct. It seems to be appreciated that we need some investigation to determine what fungus we are dealing with, so that problems which have to do with the physiological side of mycorrhiza may be understood more intelligently; for it is just as likely that knowledge concerning the fungus and its life history may lead to an understanding of the relation of the two organisms as a knowledge of the tree would. It seems worth while, therefore, to report the identity of any such mycorrhizal fungi whenever the evidence seemed sufficient to make it acceptable. In a previous paper I pointed out that the members of the genus *Cortinarius* were so constantly found in limited areas, and some species in such close proximity to certain trees, that it seemed likely that there was some connection. This last summer an effort was made to find out to what extent this might be true. The season was wet during the early summer, and although one finds few *Cortinarii* as a rule before August, several did occur, and one of these proved to be favorable for my purpose. It not only showed beautifully its connection with the tree roots, but turned out to be an undescribed species of *Cortinarius*. It was found July 4, 1905, on the south slope of a small ravine along the Huron river, near Ann Arbor, in a layer of humus and forest leaves. This species, as is indeed true of some other fleshy fungi, is characterized by its brick-red mycelial strands and stem. By removing the surface soil it was possible to see the brick-red strands intertwining with the rootlets, apparently in all directions. * * *

“But it was soon found that the reddish net-work extended along definite paths. Beginning with a tiny rootlet, the fungus was followed to a rather large root, apparently growing from a hickory. On examination, however, it was found that the mycorrhiza-bearing root passed the hickory, and that all the roots of the hickory examined were devoid of a colored mycorrhizal fungus. On the other hand, the root in question was now easily traced to a clump of red oaks. * * *

“About twenty paces down the slope, another troop of the same species of *Cortinarius* was found. These came up only 30 cm. away from a fine young sugar maple, and close to one of its main roots. Expecting that they were probably attached to the roots of an oak a short distance

away, I dug down carefully and found to my surprise that the strands which were very luxuriant here were attached to the rootlets of the sugar maple. * * *

"An ash, basswood and white oak were examined, but no trace of the fungus found. About 27 dm. from the sugar maple, it was found that some of the strands were apparently attached to a different root. Following this up to a clump of red oaks about 54 dm. away, I was again surprised to find that the oak roots in this case were not connected with the fungus at all, but that the root which was followed—which did not have the appearance of an oak root—belonged to a large *Celastrus scandens* which wound around one of the oaks. It was clear that we had another symbiont connected with the fungus. * * *

"Let it not be supposed that all Cortinari are mycorrhiza-formers, at least normally. *Cortinarius armillatus*, for example, although very partial to *Tsuga canadensis*, is usually found among rotten logs or leaf-mold near this tree, and is probably a saprophyte; on the other hand, it has been found growing out of a cleft at the base of one of these hemlock trees. It seems quite likely, however, that a good many Cortinari are in symbiotic connection in the manner of the one described in this paper. During several seasons' observations, I have found *C. squammulosus*, *C. bolaris*, and *C. cinnabarinus* again and again in places which would indicate some relation to one kind of tree. *C. cinnabarinus* seems to prefer the oak, the other two the beech. Noack has shown the connection of *Cortinarius callisteus* with the beech, *C. caerulescens* with the beech, and *C. fulmineus* with the oak. Others will, no doubt, be added to the list as soon as observers enter this interesting field."



Fig. 237.—COR-TI-NA'-RIUS RUB'-RI-PES. (C. H. Kauffman.)



Fig. 238.—CORTI-NA'-RIUS AT-KIN-SO-NI-A'-NUS. (C. H. Kauffman.)

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